

SELECTING EFFECTIVENESS ACQUISITION PROCESS METRICS

(Extracts from "Selecting Effectiveness Acquisition Process Metrics,"
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Metrics. A good metric will be meaningful, logical, simple to express, understandable, repeatedly and quickly derivable, unambiguously defined, and derivable from economically collectible data. It will indicate trends, suggest corrective actions, and numerically describe the progress toward the objective.

Metrics are not charts, schedules, goals, objectives, strategies, plans, missions, guiding principles, counts of activity, single-point statistics, or rankings. Also, tracking a process is not necessarily the same as tracking a metric.

Acquisition reform metrics are the numerical values by which we gauge progress toward meeting acquisition reform objectives...to field faster, *better*, and *cheaper* weapon systems. However, these terms have many possible meanings and we cannot directly measure these attributes. To do this we have to use "surrogate metrics." A **surrogate metric** is a measurable characteristic of the acquisition process that presumably reflects the behavior of a true metric. But it is not easy to decide what these surrogate metrics should be, and it is not always clear how they would contribute to the goal of fielding military systems that are better, faster, and cheaper.

Strategic outcome metrics. The Acquisition Reform Bench-marking Group (ARPG) established the following set of strategic outcome metrics:

- **Cost.** Measured by consumable item price index and military specification conversion price benefit.
- **Acquisition Performance.** Measured by contract defaults and contract changes.
- **Schedule.** Measured by Acquisition phase time, administrative lead time, multiyear procurements, FACNET transactions, and logistics response time.
- **Commercial Practices.** Measured by Contract specifications and credit card purchases.

Note: omission of System Performance as a Strategic outcome metric.

← NOTE: SYSTEM performance

Brainstorming Potential Metrics. Guidelines:

- Identify the specific segment of the process that is to be evaluated.
- Identify the pertinent properties of what is to be measured.
- Identify types of potential metrics.
- Select a few metrics and provide a rationale for the specific selection.
- Find bounds on what is being measured.

Information needed about a Good Metric:

- Description of the population that the metric includes.
- Identification of the source of data.
- Precise definition of key terms.
- Statement of the mathematical expressions that will be used to derive various values.
- Specification of frequency of measurements to derive the metric.
- Description of the graphics that will be used to display the data.
- Specification of user's tolerance levels (i.e., "control limits").
- Listing of desired outcomes expressed in terms of a positive or negative trend (not a numerical goal).
- Linkage between the metric and the activity being measured.
- Linkage between the surrogate metric and the true metric.

Creating a Good Metric:

- **Identify the purpose of the metric.** The purpose of the metric should reflect the purpose of the acquisition reform initiative and its mission, vision, goals, and objectives.
- **Develop an operational definition of the metric.** Define the who, what, when, why, and how of this metric in sufficient detail to permit consistent, repeatable, and valid measurement of the acquisition process.
- **Examine existing means of measuring.** Check whether existing metrics or process measuring means could be adapted to satisfy the operational definition of the metric. In other words, do not "reinvent the wheel."
- **Generate new metrics.** In the past, most metrics were not process-oriented; they were usually related to final outputs, products, or services. The focus is now on improving the new acquisition process so that superior final outputs are obtained. Currently, the underlying assumption for generating metrics is that by monitoring changes in the process we can assess process improvements.
- **Conduct a "goodness of fit" check.** Check whether the newly generated metric satisfies the previously stated attributes of a good metric. Make sure that all the previously stated details can be provided for this metric. Check objectivity of the metric to ensure that the measurements or observations do not affect the outcome.
- **Choose a mode of display.** Decide on the mode for presenting the metric. This decision will affect data collection and availability.
- **Conduct a "sanity" check.** Acquire data for deriving the metric. Derive the metric for various instances and ask the customer to judge whether the metrics are meaningful. Does the metric measure what it is supposed to measure? Do the metric values correspond to intuition? If the answer is uncertain, return to the second step.
- **Form a consensus.** Obtain consensus or buy-in from participants.
- **Create a database.** Collect and analyze the metric's data over time and for different cases. Examine trends. Can you adequately explain counterintuitive metric values? For what lengths of time does the metric stabilize (i.e., does not deviate significantly from its mean)?
- **Communicate the metric.** Be open to constructive criticism. Be ready to make adjustments.
- **Employ the metric.** Metrics are just a means to an end...continuous process improvement. If there is confidence in the metric, then it should be used; otherwise, look for a new metric. Employing the metric allows you to refine it and make it an even better tool.

Examples of Metrics: This list is not exhaustive but provide some insights into the types of metrics that are being considered in DoD and the levels of abstraction that are needed. Note: these do not necessarily meet all criteria of a good metric described above.

- **Program office overhead.** Program overhead as a fraction of total program cost.
- **Specifications elimination:** Number of military specifications that have been eliminated; or, reduction in number of specifications and standards specified in a contract.
- **Cost and pricing data.** Percentage of competitive, negotiated procurements requiring certified cost and pricing data; or, ratio of the number of contract awards with cost and pricing data to the total number of contract awards.
- **Funding stability.** The number of times a program changes in terms of quantity or cost, due to fiscal pressures external to program executive officers (or an equivalent management level).
- **Program cost.** Change in program cost as a consequence of changed acquisition processes.
- **Unit production price.** Change in unit production cost as a consequence of changed acquisition processes.
- **Unit life-cycle cost.** Change in projected unit life-cycle cost as a consequence of changed acquisition.
- **Operational performance versus cost.** Compare operational test results versus specified performance for accuracy and reliability with Average Unit Production Price Milestone I cost analysis improvement group estimates versus contractor production proposals.
- **Commercial practices.** Compare business-as-usual versus commercial practices costs.

- **Billing.** Effect of milestone billing versus cost billing.
- **Oversight.** Number of oversight personnel per program budget size.
- **Cost of performance.** The kind of system performance that can be bought for a given cost. To derive this metric it would be necessary in some way to quantify various combinations of system performance. This is a formidable task open to controversy.
- **Commercial componentry.** Percent of commercially available componentry: dollars of commercial material to dollars of total obligation.
- **System gestation time.** Time for a system or item to progress from concept exploration and definition to start of production and deployment phase.
- **Contractor's past performance.** Contractor's ranking relative to other contractors on a predetermined set of criteria.
- **Government-unique terms.** Proportion of government-unique terms and conditions to total number of such terms and conditions in a contract.
- **Protests.** Number of bid protests per number of bidders.
- **Regulatory cost premium.** DoD cost premium (%) equals contractor compliance costs (\$) divided by value-added costs (\$) x 100.
- **Value-added costs.** Value added costs as percent of total costs where value-added costs equal total costs minus costs of material purchases, including subcontracts minus profit minus corporate general and administrative allocations.
- **Contractor overhead.** Compare percentage of direct and indirect costs for top defense contractors as a group and individually over time. Use the ratio of percent indirect costs to percent direct costs or dollars of indirect costs to dollars of direct costs.
- **Consumable item price index.** Cost of a Defense Logistics Agency (DLA) pre determined set of consumables.
- **Contract defaults.** Number of contract action defaults divided by the total number of contract actions.
- **Contract changes.** Number of contract changes divided by the total number of contracts.
- **Contract protests.** Number of protests resolved using the alternative dispute resolution process, and the number of protests that go to GAO and the General Service Board of Contract (GSBCA).
- **Administrative lead time.** The average time from the signed formal requirements document to contract award.
- **Production lead time.** Time from contract award to acceptance of first item or delivery.
- **Engineering changes.** Number of engineering change proposals by program phase (demonstration and validation, engineering and manufacturing development, production startup).
- **Alternative specifications and standards.** Number of contractors offering alternatives to military specifications and standards per 100 proposals.
- **Alternative specifications and standards.** Percentage of solicitations resulting in incentive contracts where alternatives to military specifications and standards are offered.
- **Dissemination time.** Time for processing and dissemination of requests for proposal, statement of work, and specifications and standards.
- **Degree of use of simulation and modeling.** Percentage of contracts over \$5 million using simulation and modeling to changes divided by the total number of achieve cost performance tradeoffs.
- **Degree of activity-based costing and management.** Percentage of contracts and contractors that use activity-based costing and management. (Activity-based costing identifies each category of cost [direct or overhead] and relates it to the specific product [e.g., military specification or standard, statement of work task, etc.] or product line that causes the activity to be needed and performed.)
- **Marginal ownership cost.** Cost divided by operating time.
- **Technology gestation.** Time from technological innovation to operational system integration.
- **Cost as an independent variable.** Savings in a program when cost is used as independent variable.
- **Operational goals.** Probability of achieving or exceeding stated operational profiles in a specified regime.
- **Reliability goals.** Probability of system's satisfactory operation in given conditions.

- **Maintenance goals.** Proportion of maintenance activities requiring a given level of maintenance.
- **Integrability.** Ease of integrating the new system into an existing frame or organizational unit.
- **Mean time between failures (MTBF).** The average number of operating hours between system failures.

Creating a top-down hierarchy of linked metrics with Quality Function Deployment (QFD) and the Analytic Hierarchy Process (AHP). QFD/AHP provides an iterative process to systematically decompose abstract goals to underlying metrics. The QFD process is used to identify and link lower level surrogate measures (which are measurable) with higher level (but not quantifiable) measures. The process is accomplished by constructing a matrix with requirements as “whats” in rows and functional means as “hows” as columns. Weighting factors are subjectively estimated to correlate each what and how. In the next iteration the former “hows” are listed in rows as the “whats” and the next level of “hows” are identified and weighted. This scheme supports a correlation of the original “whats” with the lower level (and presumably more measurable) “hows.”

QFD as a useful process to identify useful surrogate metrics. There is risk in applying AHP weighting factors in the matrix. The intent is to quantitatively derive the best metric(s) by calculating contribution to *faster/better/cheaper*. However, adding subjectively determined weighting factors to candidate metrics of varying abstraction does not necessarily yield greater objectivity or greater validity. The process is still fundamentally subjective. The merit of the combined QFD/AHP is the insights gained through exercising the process. The contribution weighting factor is useful as a relative measure, not as an absolute one.

The IPPD Interactive Training Program provides a tutorial on QFD.